CURED IN PLACE PIPE (CIPP) RECONSTRUCTION

ITEM 901

GENERAL: (Sec. 1.0) This section includes all labor, materials, transportation and equipment necessary to rehabilitate by means of the cured in place pipe (CIPP) process, deteriorated sections of the existing sanitary sewers shown on the contract drawings.

It is the intent of the section of this specification to provide for rehabilitating sanitary sewers by means of the cured in place pipe (CIPP) process. When complete, the cured in place pipe should: (Sec. 1.2)

1. Extend from one manhole to the next manhole in a continuous length;

2. Provide flow capacity equal to or greater than that of the existing pipe;

3. Yield three-dimensional, cross linking strength in tension, compression, and flexural modulus which is structurally sound;

4. Provide a service life which is supported by documented, independent test analysis.

REFERENCE SPECIFICATIONS: (Sec. 1.3) This specification references standard specifications which are made a part hereof by such reference and shall be the latest edition and revision thereof. All work accomplished must be in strict accordance with the referenced standards.

American Society for Testing and Materials

ASTM F-1212-91	Standard Practice for Rehabilitation of Existing Pipelines
ASTM D-638	Tensile Strength
ASTM D-790	Flexural Strength
ASTM D-790	Modulus of Elasticity
ASTM D-732	Shear Strength
ASTM D-695	Compressive Strength

SCOPE OF WORK: (Sec. 1.4) The work shall include but is not limited to:

A. Cleaning of existing designated pipe and televising and videotaping of the clean pipe ("before").

B. Insertion of liner into existing sewer mains without excavation.

C. Cutting of the new cured in place pipe liner to re-establish user lateral connections without excavation.

D. Provision of by-pass pumping of flows around the pipelines affected by the lining

process. This by-pass system must be a leak-proof system.

E. Televising and videotaping of reconstructed sewer line sections ("after").

QUALITY ASSURANCE: (Sec.. 1.5) Installation of the sewer cured in place pipe lining system shall be performed by an experienced contractor. The contractor shall provide evidence of CIPP experience.

SUBMITTALS: (Sec. 1.6) Furnish the following:

A. Manufacturers Literature and Data, including physical characteristics, application and installation instructions, and recommendations for:

1. Flexible Liner Material
2. Line Design Thickness
3. Resin System

B. Procedure Report: A written report outlining the step-by-step procedures for the execution of the relining operations (i.e., length,line obstructions, excavation, etc.) shall be submitted by the Contractor prior to the commencement of work. Any deviation from the pre-specified plan for the relining operation must be presented prior to execution.

C. Tests: Tests for compliance with this specification shall be made as specified herein and according to the applicable ASTM specifications. A certificate of compliance with this specification shall be furnished by the manufacturer for all material furnished under this specification.

D. Independent Testing Report: A report listing independent testing of the CIPP structural properties and the results of these tests.

DESIGN (Sec. 2)

GENERAL: (Sec. 2.1) The Contractor shall include the recommended tube thickness for each manhole to manhole section within the scope of work, and shall supply design calculations indicating how the tube thickness dimensions were obtained. Each tube shall be designed to withstand internal and/or external loads as dictated by site conditions. Design calculations shall be in strict accordance with ASTM F-1216-93-X.I. Assume pipe ovality 3% and water loading 50% of average depth.

CAPACITY: (Sec. 2.2) The reconstructed pipe shall be designed such that the resulting capacity of the pipe is equal to or greater than that of the existing pipe. In order to maximize the capacity of the reconstructed pipe the inside diameter must be as large as possible, therefore increasing the effluent carrying area of the pipe. The chart below lists acceptable inside diameters of the reconstructed pipe.

ORIGINAL PIPE		CURED-IN-PLACE PIPE		
I.D. (Inches)	AREA (Sq. inches)	I.D. (Inches)	AREA (Sq. inches)	% LOSS of Area
8	50.3	7.528	44.5	12
10	78.3	9.528	71.3	9
12	113.1	11.528	104.4	8

The contractor may require occasional deviation from this chart where unique circumstances warrant such an action. Final approval rests with the owner's engineer or contracting officer.

SIZING: (Sec. 2.3) The tube shall be designed to a size that, when cured, will fit tightly against the internal circumference of the original conduit; this tight fit minimizes loss of original pipe size. Allowance for longitudinal and circumferential stretching of the tube during installation shall be made by the Contractor.

The Contractor shall design the length of the tube to effectively carry out installation and sealing at end points. The contractor shall verify pipe dimensions shown on contract drawings before designing and reconstructing pipe.

INSTALLATION: (Sec. 2.4) The tubes shall be designed to withstand negotiation of offsets, gaps, angles (not more than 90^0), and grades without damage to the tube during the installation process. Individual runs can be made over one or more manhole-to-manhole sections, as determined in the field by the Contractor. The tubes shall be inverted in accordance with ASTM F-1216-93.

MATERIALS: (Sec. 3) The flow line shall be accessible from each manhole.

TECHNICAL REQUIREMENTS: (Sec. 3.1) General: The liner shall be fabricated from materials which, when cured, will be chemically resistant to withstand internal exposure to sewage gases containing normal levels for domestic sewage of hydrogen sulfide, carbon monoxide, carbon dioxide, methane, traces of mercaptains, kerosene, saturation with moisture, dilute sulfuric acid, external exposure to soil bacteria, and any chemical attack which may be due to materials in the surrounding ground.

Felt Content and Liner: The felt content shall be determined by the contractor and approved by the engineer for each line section. Thickness of cured liner to be as specified (-10%;+5%) and shall not include the thickness of the polyurethane inner liner. The polyurethane liner shall be 12-18 mils in thickness.

Resin Content: The resin content of the liner shall be 85 percent by volume of the final vacuum impregnated felt tube.

MATERIALS: (Sec. 3.2) General: All materials used in the installation process shall provide, after the curing process, the minimum mechanical properties listed herein All materials shall be approved prior to the installation into the existing piping. Any rejected

material shall be replaced with approved materials at the contractors expense.

Resin: The polyester or vinylester resin shall be a resin for general chemical applications approved in advance of installation.

Fillers and Pigments: The polyester resin used shall not contain fillers, except those required for viscosity control. Up to 5 percent by mass, thixotropic agent which will not interfere with visual inspection may be added for viscosity control. Resins may contain pigments, dyes, enhances, or colorants which will not interfere with viscosity control.

Epoxy Resin: The use of epoxy resins compatible with the system to impregnate the liner may be permitted in some circumstances. The use of up to 40 percent by mass of suitable fillers may be permitted. The use of epoxy resin in any liner may be specified by the contractor, if conditions are deemed to warrant their use for approval.

Reinforcing Material: The reinforcing material of the liner shall be of a needle interlocked terylene felt or other material as approved. Liners may be made of single or multiple layer construction where any layer must not be less than 1.5 mm thick. A suitable mechanical strengthener membrane or strips may be sandwiched in between layers where required to control longitudinal stretching. The minimum thickness of a bonded polyurethane membrane and inner liner, if used, shall be 0.25 mm + 5 percent and shall not affect the structural dimension requirements of the cured in place piping.

Mechanical Properties: The cured in place pipe shall meet the following minimum strength requirements:

Tensile Strength @ Yield 20 C	2,500 psi
Flexural Strength	5,000 psi
Flexural Modulus of Elasticity	300,000 psi
Impact Strength	1.5 ft.-lb/in
Shear Strength	7,000 psi
Modulus of Elasticity-Long-Term	125,000 psi
Hardness	(Barcol) 33
Heat Distortion Temperature	70 C

Minimum thickness of finished liner for 4" pipe = 3.0 mm
Minimum thickness of finished liner for 6" pipe = 4.5 mm
Minimum thickness of finished liner for 8", 10" and 12" pipe = 4.5 mm

Finish: The finished lining shall be continuous over the entire length of an insertion run between two manholes and be as free as commercially practical from visual defects such as foreign inclusions, dry sports, pinholes and delamination. The lining shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to the inside of the lined pipe.

The inner surface shall be free of cracks and crazing with smooth finish and with an average of not over 2 pits per square foot, providing the pits are less than 3 mm diameter

and not over 1 mm deep and are covered with a sufficient resin to avoid exposure to the inner fabric. Some minor waviness that will not appreciably decrease the flow cross section or affect the flow characteristics or be the cause of a possible chokeage may be permissible if approved by the contracting officer.

EXECUTION: (Sec. 4)

Cured In Place Pipe Liner Installation: (Sec. 4.1) General: The contractor shall deliver the uncured resin impregnated liner to the site, provide all equipment required to install the liner into the conduit and cure it once in place. The liner shall be impregnated with resin not more than 24 hours before the proposed time of installation and stored out of direct sunlight in a closed container, and refrigerated to a temperature of less than 70 degrees F. The impregnated liner shall be transported to the site just prior to installation in a suitable light proof container.

Liner Installation: The liner will be installed into the conduit from a suitable platform located above the manhole or other point of installation. All labor and material required for installation shall be included in the unit price.

Cured In Place Pipe: The contractor shall supply a suitable heat source and water recirculation equipment capable of delivering hot water to the far end of the liner to quickly and uniformly raise the water temperature in the entire liner above the temperature required to commence the exothermic reaction of the resin, as determined by the catalyst system employed.

The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply to determine when uniform temperature is achieved throughout the length of the liner. Water temperature in the liner during the initial and post cure period shall not be less than 120 degrees F or more than 200 degrees F, or as specified by the resin supplier. Live steam shall not be permitted to enter the curing liner. In addition to the gauges on the incoming and outgoing water supply, there shall be thermo couples placed between the liner and the sewer pipe at the end of the liner being cured to accurately measure the liner temperature. The contractor shall submit, in writing, for approval, no less than 15 days prior to beginning work, his method of monitoring line curing temperatures.

A record of the reading of the thermocouple shall be kept and presented for each section lined.

PRIOR TO LINE INSTALLATION: (Sec. 4.2) The following procedures prior to liner installation shall be adhered to:

Cleaning of Sewer Line: Prior to a cured in place lining of pipe or line so designated, it shall be the responsibility of the contractor to clean debris out of the sewer line in accordance with 7th edition dated July 1991, National Association of Sewer Contractor (NASSCO) Specification. This work shall be considered as a part of Cured In Place Pipe rehabilitation for the appropriate pipe size and required manhole. Definitions of light,

medium, and heavy pipe cleaning.

Light cleaning - where it has been determined through a visual inspection that only small deposits of loose debris, 1 to 2 inches in depth, exists within the pipeline.

Medium cleaning - where it has been determined through a visual inspection that medium deposits of loose debris, 2 to 4 inches in depth, exists within the pipeline.

Heavy cleaning - where it has been determined through a visual inspection that heavy deposits of loose debris or root growth exists within the pipeline. Heavy equipment will be used to facilitate the removal of heavy deposits.

Bypassing Sewage: The contractor shall bypass the sewage around the sections of sewer that are to be lined. The bypass shall be made by plugging an existing upstream manhole, if necessary, and pumping the sewage into a downstream manhole of capacity and size to handle the flow. At the end of each working day, temporary tie-in shall be made between the relined section and the existing system and the bypass plug removed, but only after relined section has been cured for the proper time limit.

Line Obstructions: It shall be the responsibility of the contractor to clear the liner of obstructions and solids that will prevent the insertion of the liner.

Pipe Repair: Any pipe repair required to reline the pipe shall be made by the contractor prior to relining.

SERVICE CONNECTIONS: (Sec. 4.3) Opening of Service Connections: After the liner has been cured, all existing active services shall be reconnected, as directed by the owner.

The recommendation of services shall be done, unless otherwise directed by the Contracting Office without excavation, from the interior of the pipeline by means of a television camera directed cutting device. Location of the service shall be from the pre-cured in place pipe inspection records and camera observation.

The camera directed cutting device shall reestablish the service. The cost of testing for and re-connection service shall be included as a separate cost line item based upon unit cost per connection.

VIDEO TAPING: (Sec. 4.4) After the work on a delivery order is completed, the contractor shall supply a videotape or tapes showing the section of pipe being rehabilitated in its cleaned "before" condition and then followed by the "after" cured in place pipe lined condition. If in a section of rehabilitated pipe lateral connections are to be opened, the service connection reinstatements are to be recorded on video tape and they will be placed between the "before" and "after" on the final tape. The cost of this item shall be included in the cost line item for the cured in place pipe.

Upon completion of installation work, the contractor shall restore the project area affected by his operation and perform any surface restoration in accordance with these

Specifications. The cost of this item shall be included in the cost line item for the cured in place pipe.

EXPERIENCE, REFERENCES AND OTHER REQUIREMENTS: (Sec. 5.0) All bidders shall supply the following:

1. All applicable installation data as it relates to the method of installation and number of years experience of the installation crew.

2. A project installation list of all past projects in the State of Ohio having a scope equal to or above the scope of the proposed project. Five years experience with a minimum of five projects similar to that of the proposed project is required.

3. A statement on the bid form which indicates that bidders have reviewed the entire project site, and have taken into consideration access/restoration requirements that must be met in order to successfully complete the project.

PAYMENT: (Sec. 6.0) Payment for (CIPP) shall be a unit price per liner foot, said price shall include all work labor and material required to complete the work described in this specification.